NEW GROWTHS INVOLVING THE TERMINAL BILE AND PANCREATIC DUCTS: THEIR EARLY RECOGNITION BY MEANS OF DUODENAL CONTENT ANALYSES.[1]

By Burrill B. Crohn,

ASSISTANT IN CHEMISTRY, PATHOLOGICAL LABORATORY, MT. SINAI HOSPITAL;
FIRST ASSISTANT, GASTRO-ENTEROLOGICAL DEPARTMENT,
MT. SINAI HOSPITAL DISPENSARY.

(From the Department of Physiological Chemistry, Pathological Laboratory, Mt. Sinai Hospital, New York.)

The introduction of methods of obtaining and analyzing duodenal contents, aspirated from the upper part of the small intestine by means of the duodenal tube, has made possible a means of diagnosis hitherto unrecognized.

It is at the present time generally conceded that the chemical investigation of the contents of the duodenum gives definite information of the patency or non-patency of the bile and pancreatic ducts.[2] It will be my purpose to establish a second premise: that tumors of this region usually completely obstruct one or both of these ducts, also to demonstrate that other pathological conditions do not entirely obstruct these passages.

The natural conclusion from these two premises must necessarily follow, namely, complete absence of bile or pancreatic ferments from the duodenal contents determines the diagnosis of new growth in this region. This paper will attempt to establish from facts, the accuracy of the deduction.

In order more fully to understand the mechanism by which the patency of the bile and pancreatic ducts is obliterated by new growths, it is essential to consider the anatomical relations of these channels to the second portion of the duodenum and then to consider the various points of origin of new growths in this vicinity.

In one-third of all instances the common bile-duct does not traverse the head of the pancreas but runs along the posterior surface of this organ to enter the duodenum separately or in conjunction with the excretory duct of the pancreas. In the other two-thirds of the instances the common bile duct in its terminal portion passes through the substance of the pancreas, from which it emerges, to enter in an oblique direction the wall of the second portion of the duodenum, traversing the thickness of the gut at this point for an area varying from a few millimeters to 1 or 2 cm.

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[1] This paper is based upon studies carried on in the wards and pathological laboratory of Mt. Sinai Hospital, New York. The author desires to acknowledge the courtesy and kind spirit of coöperation shown him by the attending physicians and surgeons of the hospital during the course of this investigation.

[2] The technique of the examination of duodenal contents is fully considered in a paper by the author published in the Amer. Jour. Med. Sci., 1913, cxix, 393.

The bile duct may now penetrate the intestine and open alone into the duodenum, or, as is more common, it may unite with the pancreatic duct, thus forming a common channel, the ampulla of Vater. This ampulla is only a few millimeters in length and breadth and opens into the lumen of the second part of the duodenum, less often directly or more usually through a small knob of tissue, the papilla of Vater, which projects inwardly from the mucosa of the intestine.

It is thus noted that many variations may occur in the course and method of exit of the common bile duct in its relation to both the pancreatic duct and the duodenum. Letulle and Lorrier[3] distinguish the following four common types (see figure):

(*a*) The ducts unite to form a common ampulla. This is considered the normal arrangement.

(*b*) The ducts unite while still some distance from the lumen of the intestine and enter the intestine by a small common channel, but without the formation of an ampulla.

(*c*) The ducts open separately into the intestine without the formation of either ampulla or papilla.

(*d*) The ducts open separately, but through the formation of a papilla.

Because of the great variability in the course of these ducts and in their relationship to each other it will be readily conceived that the obstructive capacity of a new growth arising in this vicinity will depend in great part upon the anatomical conditions which it finds as well as upon the point from which it arises and the direction in which it grows.

ORIGIN OF NEW GROWTHS IN THIS REGION. We recognize six principal points from which a new growth can originate in this vicinity:

1. The common bile duct.
2. The ampulla of Vater.
3. The duct of Wirsung.
4. The papilla of Vater.
5. The duodenal mucosa.
6. The head of the pancreas.

TYPE 1. *Carcinoma of the Common Bile Duct at or Near its Termination.* This point of origin is fairly frequent as compared with the ampulla of Vater or the duct of Wirsung as a starting-point. One third of all new growths of the bile ducts arise in the lower or terminal portion of the choledochus (Rolleston[4]). Growths originating here are practically always carcinomata. They are small white or pinkish tumors, which early encircle and constrict the lumen of the duct, causing complete obstruction to the passage of bile. The tumor usually grows along the course of the duct and outward into the duodenal wall, infiltrating the mucosa and finally ulcerating freely into the lumen of the intestine. Once the carcinomatous process reaches the mucous surface of the duodenum it may spread rapidly over this surface as an ulcerating necrosing tumor. Involvement of the duct of Wirsung and the head of the pancreas may also occur.

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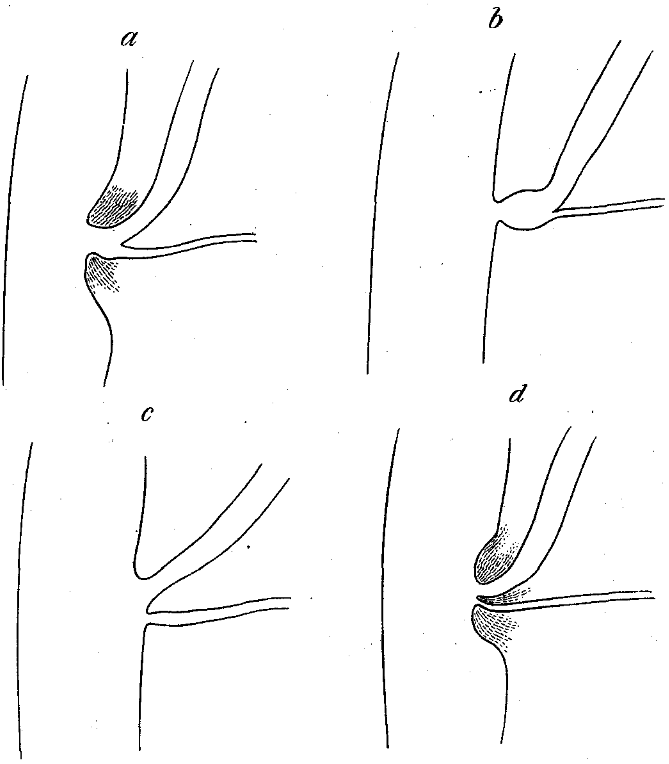
[3] Quoted from Robson and Cammidge, The Pancreas, its Surgery and Pathology, 1907, p. 59.

[4] Diseases of the Liver, Gall-bladder, and Bile Ducts, 1912, p. 691.



Diagrammatic representation of variations that may occur in the course and method of exit of the common bile duct in its relation to both the pancreatic ducts and duodenum. (Modified from Robson and Cammidge.)

The duration of this form of carcinoma is five to six months. Local glandular metastases are frequent, involving the lymph nodes on the posterior surface of the head of the pancreas and those in the pancreaticoduodenal angles. The liver may also show a few metastatic nodules. The symptoms are those of gradually increasing and unremitting jaundice, associated with loss of weight and cachexia. In this type of case the gall-bladder is usually firm and globular and distinctly palpable. The stools are acholic.

The clinical picture may be confused by attacks of abdominal colic simulating gall-stone colic, so-called "pseudo-gall-stone colic." Though gall-stones are present in at least one-third of the cases of choledochus carcinomata, yet it is generally recognized that such attacks of pain are due to irritative spasm of the duct, or spasmodic contractions of the tense gall-bladder. The following case is an illustration of the foregoing type:

Case I.—L. K., female, aged sixty-eight years, was admitted to the service of Dr. J. Rudisch in December, 1913, with the history of gradual appearance of jaundice four months before, associated with sharp cramp-like attacks of pain in the epigastrium, occurring at irregular intervals, frequently at night, and worse after eating. The pains radiated to the right shoulder posteriorly. Vomiting occurred synchronously with the attacks of abdominal cramps. There had been steady loss of appetite and progressive loss of weight.

On physical examination an emaciated woman was seen, deeply jaundiced with a dark olive tint of icterus. The edge of the liver was just palpable at the free border of the ribs. In the region of the gall-bladder an indefinite mass was felt on several occasions, though not constantly. A secondary anemia was present.

The examination of the stool showed blood several times; at first the stool, while acholic, contained no excess of muscle fiber and no neutral fat microscopically. During the progress of the disease both neutral fat and a great excess of muscle fiber appeared.

The duodenal tube was passed on two occasions ten days apart. Both times the contents were milky white in color, slightly acid, and exhibited no trace of bile on chemical examination. The pancreatic ferments were completely absent.

A diagnosis of complete obstruction of both bile and pancreatic ducts by a neoplasm was made.

The patient declined rapidly, evidencing progressive emaciation and unremitting jaundice. Death occurred six and a half months after the onset of the symptoms.

At autopsy (performed by Dr. Wm. Thalhimer) an ulcerated necrosing carcinomatous mass occupied the second portion of the duodenum, overlying and involving the head of the pancreas. The tumor extended upward into the first or descending portion of the duodenum almost to the pylorus.

The common bile duct in its intraduodenal course was laid bare and open by the necrosing mass; the upper end was involved by new-growth tissue, the lower end of the duct was found intact as it entered the preserved papilla of Vater. The duct of Wirsung could not be probed beyond its termination in the papilla, as it soon entered the carcinomatous tissue and its lumen was obliterated. The malignant growth had infiltrated the head of the pancreas;

the body and tail of the gland in addition showed advanced, almost complete fibrous atrophy.

The surface of the liver appeared studded with a few small nodules of new growth; the gall-bladder was slightly distended. Metastatic infiltration occurred in the retropancreatic lymph nodes.

The histology of the tumor was that of a cylindrical-cell adenocarcinoma, such as might arise either from the bile duct or the intestinal mucosa.

The centre of the crater of the tumor, its oldest portion, was located over the terminal portion of the common bile-duct, and this was therefore regarded as the probable point of origin.

In this case the duodenal contents, giving definite knowledge of complete closure of both the large excretory ducts of liver and pancreas made possible a definite diagnosis of neoplasm.

TYPE 2. *Carcinoma Arising in the Ampulla of Vater.* This type of carcinoma is rare, Rolleston,[5] in 1912, being able to cite only nineteen genuine cases. Hanot,[6] who has given us one of the clearest descriptions of this variety of cancer, termed it "cancer du pylore pancreaticobiliaire," in contradistinction to neoplasms arising from the duodenal surface of the papilla or from the bile duct. It occurs as a small papillary outgrowth usually limited to cherry size, springing from the inner folds of the mucous membrane lining the ampulla. Such a growth by its mechanical position blocks the two large ducts entering to form the cloaca.

Biliary as well as pancreatic stasis is usually absolute. Secondary inflammatory and obliterative changes in the pancreas occur. Death takes place within nine months from cholemia or emaciation. Secondary growths occur only in the liver, and these in but 20 per cent. of the cases. Histologically these tumors are cylindrical-cell carcinomata.

Of this rarer type I have no examples to offer. Theoretically the duodenal contents in such a case should exhibit absence of both bile and pancreatic ferments.

TYPE 3. *Neoplasms Arising in the Duct of Wirsung.* This is an exceedingly rare form of growth, not more than two or three authenticated cases being on record. It is claimed by Letulle[7] that these tumors are always spheroidal-cell carcinomata. The case reported by Carnot and Harvier[8] is a good illustration. The history is that of a woman, aged sixty-one years, who suffered from attacks of pain and vomiting. Ten months later she developed a progressive and intense jaundice, accompanied by advancing emaciation. Death followed an attempt to puncture the distended gall-bladder.

At autopsy a small tumor, the size of a lymph node, occupied the mouth of the Wirsungian duct at its point of entrance into the ampulla. Complete obstruction of both bile and pancreatic systems was present. The tumor was an adenocarcinoma composed of atypical cuboidal cells. No metastases, either glandular or hepatic, were found.

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[5] Loc. cit., p. 703.

[6] Arch. Gén. de Méd., 1896, ii, 547.

[7] Presse Médicale, 1906, xiv, 256.

[8] Bull. et Mém. de Soc. de Méd. d'Hôp. de Paris, 1906, xxiii, 296.

Of this type of case, with origin in the terminal portion of the duct of Wirsung, I have no example to offer.

TYPE 4. *New Growths Arising from the Duodenal Surface of the Papilla of Vater.* This point of origin is a more common one, if not the most common, of this group. Of all duodenal carcinomata, 66 per cent. spring from the mucosa of the papilla, forming the so-called "circum-papillary" tumors. Carcinomata arising here are usually cylindrical-cell in structure and histological appearance. They vary in size from a small pea or nut to that of the phalanx of the little finger,[9] being also described as assuming the magnitude of a small lemon. The form usually taken is that of an excavated or eroded ulcer, depressed in its centre, with raised, overhanging, thickened, carcinomatous walls. The tumor grows by extension into the surrounding tissues, the centre ulcerating the deeper strata while the edge advances. Severe, often fatal hemorrhage frequently results from erosion of larger vessels in the base of the ulcer. In its progress it invades the large excretory ducts in this region, causing obstruction to biliary and pancreatic outflow. Later, as necrosis progresses, these ducts are laid open, thus allowing entrance to infecting bacteria. Suppurative cholangitis and multiple hepatic abscesses are common sequelæ of this type of neoplasm. Metastases occur late in the regional lymph nodes and in the liver, more rarely in the peritoneum and distal organs. The duration of the illness varies from seven to fifteen months, death occurring from icterus gravis, progressive emaciation, hemorrhage, or hepatic infection.

The symptoms are those of obstructive jaundice, associated with diarrhea, melena and emaciation. Rigors and a febrile course are common. The liver is enlarged, the gall-bladder usually palpable. The icterus in this type of case may be intermittent, depending on whether the new growth is in the stage of infiltration and obstruction or in the later stage of necrosis with the release of the withheld secretions. Of this class of carcinomata the following two cases are typical:

CASE II.—D. S., male, aged sixty years, was admitted to the service of Dr. A. G. Gerster May 28, 1913, giving a history of illness of four months' duration, characterized by gradual appearance of jaundice, sour eructations, nausea, and heaviness after meals. The stools had been white since the onset of the jaundice. There had been a loss of weight since the onset of the illness.

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[9] Clermont, Rev. de Gynéc. et de Chir. Abdominale, 1913, xx, 33.

On examination the man was seen to be emaciated, deeply icteric; the liver was palpable three fingers' breadth below the free border of the ribs as a smooth, even edge. The gall-bladder was not palpable. Occult blood was present in the stool; the urine was repeatedly negative for sugar. Irregular fever was present.

On operation a mass was felt occupying the head of the pancreas; a cholecystostomy for the relief of jaundice was performed. Death occurred four days later, the patient never having rallied from the shock of the surgical intervention.

At autopsy (performed by Dr. William Thalhimer) an excavated cacinomatous ulcer was noted, occupying what had been the site of the papilla of Vater; the growth was about 2 cm. in diameter, irregularly round, with worm-eaten centre and slightly raised, thickened, carcinomatous rim. Both the common bile and pancreatic ducts were enormously dilated at their termination to the size of an adult little finger; the dilatation of these duct systems extended throughout their entire extent to the capillary origins in liver and pancreas. The terminals of the ducts opened directly into the base of the carcinomatous ulcer, a very fine probe being passable from the duodenal surface into the lumen of the pancreatic duct, but not into that of the bile duct. The duct of Santorini was present, much distended, but ending blindly in the inferior portion of the pancreatic head.

The liver presented two small nodular metastases on its anterior and superior surface. A small lymph node, underlying the head of the pancreas, was infiltrated with new growth.

On microscopic examination the tumor consisted of a cylindrical-cell carcinoma. The pancreas evidenced an advanced interstitial inflammation of the perilobular type. The islands of Langerhans were well preserved throughout.

The duodenal contents of this case, aspirated before the operation, presented a complete absence of bile; pancreatic ferments were present and only very slightly diminished from their normal strength. The diagnosis of complete closure of the bile duct, but patent pancreatic duct, was confirmed by the autopsy findings above quoted.

It is evident that at the time of examination and of death the tumor had advanced to that stage at which carcinomatous infiltration had obstructed the bile duct, but secondary necrosis at its base had allowed a leakage of pancreatic secrétion. The enormous dilatation of the entire pancreatic duct system was prima facie evidence of previous long-standing occlusion of these excretory channels.

Case III.—L. J., male, aged forty-eight years, was admitted to the medical service of Dr. N. E. Brill, giving a history of eight days' duration, characterized by constipation and increasing though painless jaundice. On physical examination a moderately well-nourished man was seen, with a jaundice of a light saffron hue. On abdominal palpation no masses were felt; the liver extended to one finger below the free border of the ribs. The gall-bladder was not palpable. The temperature was slightly elevated during the first two weeks in the hospital, then becoming normal. Blood-count: leukocytes, 6400; polymorphonuclears, 59 per cent.; lymphocytes, 31 per cent.; eosinophiles, 9 per cent. to 12 per cent. Urine repeatedly negative for sugar. The stools were dark brown and large, free fat and muscle fiber being absent; blood was chemically present.

The course of the patient during this time was one of gradual improvement, the jaundice slowly clearing up, temperature becoming normal, and general condition improving. The patient was discharged, twenty-five days after admission, practically well.

Seven weeks later he was readmitted to the hospital, stating that he had remained free of symptoms until four weeks before, when the jaundice had reappeared. His stools had become yellowish white and urine dark brown. He now stated that he suffered from occasional attacks of epigastric pain. On physical examination the liver was felt three fingers below the free border of the ribs, and was tender. The gall-bladder was palpable as a small globular mass. During the four days that elapsed before the operation the temperature assumed a distinctly septic curve, reaching 104° to 105° F. in the evening and approaching normal during the morning.

At operation a small mass was noted occupying the head of the pancreas; the liver was much enlarged and studded with abscesses; the gall-bladder was distended. Cholecystostomy was performed. Death occurred on the succeeding day from shock.

At autopsy (performed by Dr. Olitzky) the site of the papilla of Vater was replaced by an irregularly circular carcinomatous ulcer, 2.5 cm. in diameter. The centre appeared depressed, uneven, and covered with irregular linear depressions and ridges. The edges were thickened and overhanging, composed of pinkish, firm tissue. The choledochus and Wirsungian duct both entered the base of the ulcer, being much dilated throughout their extent. The bile duct was completely closed off by the infiltrating tumor; the pancreatic duct allowed the passage of a fine probe.

The liver was much enlarged, and riddled with smaller and larger abscesses containing thick mucoid pus. The hepatic ducts and their radicles were enormously dilated.

The pancreas was slightly firmer than normal. On the posterior surface of the head was an enlarged lymph node infiltrated with carcinoma, also a similar node in the superior pancreaticduodenal angle. No other metastases were present in the body.

Histologically the tumor was an adenocarcinoma composed of cylindrical cells. The pancreas showed considerable atrophy of the parenchyma; the islands of Langerhans were retained throughout.

Duodenal contents obtained from this patient on his first stay in the hospital showed an abundance of thick mucoid bile and very active pancreatic ferments. Reëxamination of duodenal contents after his return to the hospital presented a complete absence of bile; pancreatic ferments were present, though distinctly weaker than on the previous examination.

It is evident in this case that at the time of the first examination with the duodenal tube (two weeks after the onset of symptoms) the growth, then in an early stage, had obstructed the bile duct, causing the jaundice, but already partial necrosis of the tumor had reopened the mouth of both ducts. The jaundice at this date was disappearing.

At the later examination the growth had progressed, completely closing off the bile duct in its advancing infiltrating border, but ulcerating in its centre and allowing the escape of pancreatic secretions. The diminution in the strength of the ferments gave evidence of increasing damage to the pancreatic tissue. At autopsy the enormous dilatation of the two drainage systems offered proof of long-standing and probably complete obstruction for a variable period, followed by necrosis over the mouth of the Wirsungian duct.

TYPE 5. *New Growths Arising from the Duodenal Mucosa.* This group includes only those neoplasms arising from the mucous membrane of the duodenum, exclusive of those arising from the papilla of Vater, the so-called "circum-papillary" tumors described as Type 4.

Carcinomata of the duodenum are rare, forming only 2.3 per cent. of all intestinal cancers or 0.3 per cent. of all cancers (N. E. Brill[10]). According to Rolleston,[11] three-quarters of the carcinomata of the small intestine occur in the duodenum. Of 36 cases of duodenal cancers, 8 occurred in the first portion alone (juxtapyloric), 24 in the second portion (including "papillary" cases), and 4 in the third portion alone (infrapapillary)

Carcinomata arising in the mucosa of any part of the duodenum may increase in size by extension so as to involve the papilla of Vater or the openings of the large ducts, and so may simulate carcinomata of the papilla or pancreas head.[12] These tumors are cylindrical-cell adenocarcinomata in type and behave essentially like those of papillary origin. They necrose freely, and in so doing may secondarily release the restrained contents of the ducts.

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[10] AMER. JOUR. MED. SCI., 1904, cxxviii, 824.

[11] Lancet, 1901, April 20, 1121.

[12] In a case reported by Brill (Mt. Sinai Hospital Reports, 1903, iii, 49), the bile duct at autopsy was opened through secondary ulceration; the Wirsungian duct was caught and closed by the tumor.

Sarcoma of the duodenum is rare, Libman,[13] in 1900, being able to collect from the liberature on the subject only 15 cases. They are characterized by a diffuse infiltration of the walls of the duodenum, dilatation rather than constriction of the intestinal lumen, ulceration, and hemorrhage. Extension into the pancreas and other contiguous organs is common.

The following case, reported in full by Brill,[14] is given here in abstract as a study of this type:

Case IV.—A. F., male aged eighteen years, suffering for three and one-half years with attacks of sharp epigastric cramps, vomiting of greenish material, and constipation. Attacks continued until six months ago, when he was operated upon and the vermiform appendix removed. He was told that he had cholangitis. The attacks soon recurred after his operation, being characterized by epigastric pain, eructations, and pyrosis. Four months ago he became jaundiced. The bowels moved four to five times daily. He had chills and fever every day, and lost twenty-seven pounds in weight.

Physical examination showed a drowsy, pale, markedly jaundiced boy. There was general glandular enlargement; the liver was not palpable, nor was the gall-bladder palpable.

Blood examination: hemoglobin, 22 per cent.; red blood cells, 1,500,000; white blood cells, 13,000; polymorphonuclears, 85 per cent.

The stool contained blood, but no free fat or excess of muscle fibers. The febrile course was irregular, there being daily afternoon rises. After three months of progressively increasing anemia and emaciation the patient died.

At autopsy (performed by Dr. E. Libman) a friable, necrotic, round-cell sarcomatous mass was found infiltrating the duodenum and extending into the head of the pancreas. The pancreatic and bile-duct systems showed enormous dilatation; the sarcomatous mass had invaded and infiltrated the mouth of both ducts, but the new-growth tissue was of such a soft, friable nature and ulceration had so progressed as to allow of the later seepage of the contents of these ducts through the tumor.

The duodenal contents were obtained from this case on three occasions at intervals of one month. On the first occasion there was complete absence of both bile and pancreatic ferments. This was the stage of obstruction. One month later there was still complete absence of bile, but traces of pancreatic ferments were present. Again one month later traces of bile were present, and also pancreatic ferments in quite normal strength. The earlier complete obstruction had given way, through necrosis of the mass to more or less free leakage of the pancreatic and biliary secretions into the duodenum.

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[13] Amer. Jour. Med. Sci., 1900, cxx, 309.

[14] New York State Jour. of Med., 1912, xii, 449.

TYPE 6. *New Growths Arising in the Head of the Pancreas.* Primary carcinomata of the head of the pancreas occur fairly often. It is impossible to estimate from the accumulated literature of years the relative frequency of primary pancreatic tumors as compared with those arising in the large ducts or in the papilla of Vater, for, except in the most recent literature, these various types were all described under the general heading of "carcinomata of the head of the pancreas." Pitt[15] quotes Biash's figures for the frequency of pancreatic carcinoma as 0.12 per cent. in comparison with 0.30 per cent. for duodenal carcinomata; new growths arising in the common bile and pancreatic ducts are relatively much rarer than either of these types.

Carcinomata arising in the head of the pancreas are classically described by Bard and Pic;[16] these tumors are usually spheroidal-cell or cuboidal-cell neoplasms, occasionally colloidal. They grow slowly in the head of the gland, sooner or later involving the duct systems that traverse the organ, to obstruct them. They advance by contiguity infiltrating the surrounding tissues and organs.

The clinical symptoms are those of gastric disorder (nausea and vomiting), attacks of epigastric pain, emaciation, and weakness. When the ducts are involved, obstructive jaundice and fatty diarrhea supervene. Secondary infiltration of the duodenum, when it occurs, creates great difficulty in differentiating these tumors from primary duodenal growths. Metastatic deposits in distal organs are common and take place comparatively early in the course.

The following two cases are typical instances of moderately advanced pancreatic growths:

CASE V.—T. L., male, aged fifty-one years, admitted to the service of Dr. H. Lilienthal, for two and one-half months complained of epigastric pain radiating to the back, griping in character. He had frequently vomited two hours after eating. During the last three weeks he had become jaundiced. There had been marked loss of weight. Physical examination was negative except for jaundice and emaciation.

On operation an enlarged gall-bladder was noted; a stony, hard, carcinomatous mass occupied the head of the pancreas. Cholecystostomy was performed.

The duodenal contents before operation showed faint traces of bile; pancreatic ferments were normally present. Two months after operation, duodenal contents were again aspirated. On this occasion no bile was obtained, but pancreatic ferments were again present and quite within normal limits of strength.

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[15] Allbutt and Rolleston's System of Medicine, 1910, vol iv, Part 1, p. 303.

[16] Rev. de Méd., 1888, viii, 257.

It is quite probable that at this point the pathological process had advanced so as to infiltrate and obstruct the bile duct.[17] This patient died eight months later after the typical course of carcinomatous emaciation and cachexia.

CASE VI.—P. V., male, aged sixty-seven years, was admitted to the service of Dr. A. V. Moschcowitz May 22, 1914, giving the following history: Two years ago he suddenly suffered abdominal pains, of a cramp-like nature, localized in the right hypochondrium and radiating to the right and posteriorly to the back. After a few days of severe pain relief was felt. No jaundice was noted.

Six months ago he again experienced sudden abdominal pain about the umbilicus, lasting only a few hours. Since then he had been free of pain, but had noticed a gradually increasing degree of jaundice, with itching of the skin and pale motions. His urine was correspondingly dark. He lost a few pounds in weight.

On physical examination a deeply icteric, poorly nourished man was noted. The most essential points in his examination were the presence of a smooth, palpable liver, the anterior border of which extended to one finger below the free border of the ribs; also a mass attached to the under surface of the liver and moving freely with it. A secondary anemia of a mild grade was present.

The test meal, an Ewald test breakfast, showed complete absence of gastric acid, both free and combined. There was no blood present. The bleeding time of the patient was one and one-half minutes; coagulation time of the blood, four minutes.

At operation a markedly distended gall-bladder immediately became visible. This was emptied by aspiration of over 200 c.c. of dark, viscid bile. No gall-stones were felt. The pancreas was infiltrated and hard, and suggested to the touch new growth; a palliative cholecystduodenostomy was hastily performed for the relief of the intense jaundice and pruritus. The patient died on the succeeding day of shock and hemorrhage.

At autopsy (performed by Dr. Aschner) a normal sized though firm pancreas was seen to surround completely and to compress the common bile duct in its terminal portion. The duct traversed the head of the pancreas, opening alongside but independently of the duct of Wirsung by means of a well-formed papilla of Vater. The choledochus could not be probed from the duodenal end, resistance being encountered within 0.5 cm. of the intestinal opening. On incising the choledochus it was seen that for a distance of 1.5 cm. the lumen of the duct was completely closed by the inward pressure of pancreatic tissue. Above this point the choledochus was enormously dilated, the dilatation of the biliary duct system extending upward throughout all its subdivisions and into the liver. The liver was enlarged and the ducts distended; no new growth was present. The pancreatic duct was not dilated; it was patent throughout.

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[17] On many other occasions on which duodenal contents had been aspirated from patients with cholecystostomy drainage, bile was aspirated in large quantities when the bile duct was shown to be open, and none was obtained where permanent obstructive processes existed.

The pancreatic tissue was firm and hard and exhibited numerous small cysts throughout its extent, these cysts being pea sized and containing thick, clear mucus. Two enlarged soft lymph nodes were removed from the posterior surface of the gland.

Histological examination (performed by Dr. George Baehr) demonstrated a diffuse colloid carcinoma with cyst formation, occupying the entire pancreas; associated with the new growth was an advanced interstitial and intra-acinar pancreatitis. The lymph nodes contained colloid-carcinoma.

In this case the duodenal contents were aspirated on two occasions before the operation. Each time there was a complete absence of bile; on both occasions the pancreatic ferments were present, though distinctly weak.

From these findings it was argued that we were dealing with a carcinoma in or about the common duct in the head of the pancreas; the marked diminution in the strength of the pancreatic ferments suggested strongly either a chronic pancreatitis or a complete disorganization of the pancreas by an extending neoplasm. Both deductions were correct, and were supported by the autopsy findings.

REMARKS. A survey of the preceding types of cases, with reference particularly to the duodenal content analysis of each class, brings forth the following deductions:

TYPE 1. *Carcinomata of the Common Bile Duct.* These cases cause early and complete obstruction of the bile system; in their later extension they may, and frequently do, involve in addition the Wirsungian duct, and completely obstruct it. In Case 1, quoted, the diagnosis was made upon the complete absence of bile and ferments from the duodenal contents.

TYPES 2 AND 3. *Carcinomata of the Ampulla of Vater and of the Duct of Wirsung Near the Ampulla of Vater.* These cause complete obstruction to both of the main duct systems. No original cases with duodenal content studies are quoted. It is probable that both bile and ferments would be absent in these rare cases.

TYPE 4. *Carcinoma of the Duodenal Surface of the Papilla of Vater.* This is a more common type and progresses through two phases: an earlier one of obstruction to the ducts and a later one of necrosis and ulceration with secondary release of the dammed-up contents. It is evident that the duodenal content findings will vary with the stage of advancement of the lesion. In Case II, quoted, bile was absent but pancreatic ferments present; in Case

III, on first examination, both bile and ferments were present (the patient's jaundice was disappearing; evidently necrosis of the tumor had just relieved the ducts). The second examination, weeks later, showed the bile duct completely obstructed but the pancreatic duct still open. The autopsy confirmed these findings.

TYPE 5. *Neoplasms of the Duodenal Mucosa.* These usually grow rapidly and enmesh the mouth of the ducts to obstruct them. A sarcoma (Case IV) is given as an example. The duodenal contents showed absence of both secretions; later examination evidenced some pancreatic ferments and traces of bile leaking through.

TYPE 6. *Carcinomata of the head of the pancreas* frequently avoid the ducts early, but later infiltrate them. Case V is such an illustration, the first analysis of duodenal contents showing both ducts patent, the second examination, obstruction of the bile duct, but Wirsungian duct still patent. Case VI is a similar illustration of this point.

From this summary one fact, at least, seems evident: that new growths in this region usually obstruct one or both ducts completely at some stage of their existence, and that such obstruction is demonstrable with the duodenal tube. Clinically it is not possible to differentiate the various kinds of carcinoma that invade this area. An early and definite diagnosis of new growth versus an impacted stone or obstruction from other cause would be a distinct advantage in that it would make possible immediate surgical intervention.

Complete obstruction of both the main ducts, as evidenced by the duodenal pump, is caused only by neoplasms. Cases I and IV are examples of this point, and the following two illustrations further support the deduction:

CASE VII.—Referred (by Dr. Walter M. Brickner) for duodenal content examination. Mrs. D., aged sixty-two years, noted during the last two weeks increasing painless jaundice, pale-colored motions, and weakness. Physical examination showed an extremely obese woman, markedly icteric. Neither the liver nor the gall-bladder could be felt. The obesity of the patient precluded exact manual palpation.

The duodenal contents showed complete absence of both bile and pancreatic ferments; on this basis a diagnosis of tumor involving the exit of both ducts was made. The patient died after eight months of illness, having developed masses in the liver, ascites requiring tapping, progressive cachexia, and emaciation.

CASE VIII.—Admitted to the service of Dr. Charles A. Elsberg April, 1914. A woman, aged forty-eight years, suffered for three months with absolute jaundice, intense pruritus, and weakness. Bowel movements were large, white, and offensive in odor. She lost twenty-three pounds in weight. Physical examination evidenced a stout, deeply jaundiced woman; on palpation a large mass, thought to be the distended gall-bladder, occupied the right upper abdominal quadrant. The liver was palpable one finger below the free border of the ribs. Blood was present, chemically, in the stool. The duodenal contents showed blood, but complete absence of bile and ferments. At operation a large carcinomatous mass was felt, infiltrating the head of the pancreas.

Is there any other pathological condition which causes complete closure of both bile and pancreatic ducts? In an experience of three and a half years in the examination of duodenal contents from 102 cases, including 50 cases of obstructive jaundice of doubtful origin, we have met with no instance of this nature except those due to neoplastic obstructions. Complete closure of the pancreatic duct alone has occurred only from tumor formations.[18]

The combination of closed bile and open pancreatic duct is commonly observed. Absolute closure of the bile duct is practically always caused by a new growth; in this series of 50 cases with jaundice no other condition but malignancy has been shown to produce absolute biliary stasis, with the following exceptions:

Two cases of stricture of the bile duct following operation upon and direct drainage of this duct (choledochotomy), and one case of chronic intra-acinar and interlobular pancreatitis of advanced degree. In this last case the second examination of duodenal contents showed bile, so that evidently the obstruction was here not really absolute.

Five cases of jaundice due to a stone or stones in the common bile duct presented only partial biliary stasis and no interference with the passage of pancreatic secretions. The statement that stones never cause complete blockage of the common bile duct may appear too sweeping to the view of some surgeons who have experienced large stones firmly impacted in the choledochus near the ampulla, and apparently completely blocking its lumen. Yet the duodenal findings seem clearly to point to the fact that stones do not completely block this duct while neoplasms usually do.

This fact is not a new one, though not usually recognized. For many years it has been known that stercobilin (hydrobilirubin) in the stool speaks in favor of stone obstruction, its absence in favor of neoplasm.

Courvoisier's law, of the enlargement of the gall-bladder to a palpable mass in new-growth obstruction and its failure to do so in stone, is known to be correct in 80 per cent. to 90 per cent. of the cases only. Cases in which the law fails to hold true are probably those in which the malignant process has ulcerated and allowed a partial escape of bile into the duodenum. In corroboration of this hypothesis the following table is offered:

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[18] The question has often occurred, "Will not the accessory duct of Santorini allow the free entrance of pancreatic ferments into the duodenum where a new growth is blocking the Wirsungian duct?" If the accessory duct were present and patent a false idea might be obtained regarding the patency of the main duct. However in four cases of malignant obstruction of the Wirsungian duct in only one instance was the accessory duct found at all, and in this case the duct of Santorini, much dilated, ended blindly in the head of the pancreas. In the other three examples it was either congenitally absent or previously atrophied. It would thus seem that the duct of Santorini is of more anatomical interest than of pathological importance.

Case.	Bile duct (duodenal content examination).	Gall-blader.	
1.	Obstructed.	Palpable.	
2.	Not obstructed.	Not palpable.	
3. First examination.	Not obstructed.	Not palpable.	
Second examination.	Obstructed.	Palpable.	
4. First examination.	Obstructed.	Not palpable	Patient a very difficult one to palpate.
Second examination.	Obstructed.	Not palpable	
Third examination.	Not obstructed.	Not palpable	
6.	Obstructed.	Palpable.	
7.	Obstructed.	Palpable.	
8.	Obstructed.	Too obese for satisfactory palpation.	
9.	Obstructed.	Palpable.	

Association of stone with tumor of the common duct has been noted in only two cases; the symptoms are those of tumor.

Pancreatitis, acute or chronic (six cases), blocks neither duct; the one exception has already been mentioned.

Hypertrophic cirrhosis of the liver leaves the ducts free, with profuse discharge of bile and ferments.

THERAPY. Having established an early diagnosis of new growth, on the basis of duct closure, it is in the direction of the ever-increasing scope of surgery that we must look for escape from a condition otherwise hopeless. Exclusive of carcinoma arising in the head of the pancreas itself, carcinomata of the other five types have this in common: they grow slowly, increase gradually by extension, involve only the regional lymph nodes directly adjacent to the head of the pancreas, and form distal metastases (practically only in the liver) late in their course.

The remarks of Letulle,[19] in 1906, should be quoted in full, as they most succintly and clearly point the way to the most reasonable management of these cases:

"All observers note the striking contrast between the gravity of the secondary disorders and the minimal volume and relative benignity of the causal lesion, circumscribed as it is to the zone called by Hanot the pancreatic-biliary pylorus. They have all regretted not having called upon modern surgery for an early interference."

Radical operative procedures have been attempted since the year 1900. Twenty-three cases operated upon have been collected by Clermont,[20] in 1913, and the names of the surgeons include some of the most illustrious of our times—Czerny, Körte, Riedel, Kraske, Cuneo, Mayo, Halstead, and others. The operations have consisted in the most part in an attempt to remove locally the new growth with or without the surrounding duodenal wall. Cholecystenterostomy as part of the operation has often been performed.

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[19] Loc. cit.

[20] Loc. cit.

Locally, three different procedures have been attempted:[21]

1. Simple Papillectomy. This operation has been carried out in 8 cases, with the following results: death following operation within eleven days, 3; within eight weeks, 1; death from metastases (after eighteen months), 1; alive at time of writing, 3 (one six months, one six and a half years, one one and a half years).
2. Papillectomy with partial excision of the duodenum (10 cases): Died within a few days of hemorrhage or infection, 4; died of metastases (eight months to two and a half years), 5; alive and well two years after operation, 1.
3. Papillectomy with complete resection of duodenum (3 cases): Died within a few days of operation, 2; lived nine months after operation (died from secondary procedure necessitated by cholangitis and hepatic infection), 1.

Several facts are apparent from a review of these figures:

1. The operative mortality is high (43 per cent).
2. Death from metastases is frequent (28.5 per cent); death from subsequent infection and other causes occurs (10 per cent.).
3. Four cases had remained alive, at the time of Clermont's publication, from six months to six and a half years (19.5 per cent.).

In spite of the apparent disproportion between the number of cases that have succumbed and those that have survived, the latter statement outweighs in importance the former, for it embraces in itself the hope of the future. Increasing surgical skill, earlier diagnosis, and a better acquaintance with the pathological processes that occur here undoubtedly will, before long, bring vastly improving and more gratifying results.

Kausch,[22] after operating upon three such cases, has suggested and once performed a two-stage operation of the following nature:

First Stage. Preliminary cholecystenterostomy. This operation relieves the jaundice, improves the nutrition of the patient, and helps to overcome the tendency to hemorrhage at the subsequent laparotomy.

Second Stage. Radical excision of tumor, duodenum, and involved head of pancreas; blind closure of upper end of duodenum; implantation of ablated head of pancreas and common bile and pancreatic ducts into lower end of duodenum; gastro-enterostomy.

Cotte[23] had previously suggested this operation, all in one stage, but subsequently modified his views and proposed the same procedure in two stages.

This two-stage operation will in the future probably become the operation of choice. Though a common practice, it is futile for a physician who makes the diagnosis of "cancer of the head of the pancreas" to resign himself and the patient to the attitude of "there is nothing more to be done." He should remember and understand that a large majority of the so-called tumors of the head of the pancreas are really small localized growths of the common bile duct, ampulla, or papilla of Vater. The greatest number of patients suffering from this disease enter the hospital two to three months after the onset of jaundice. The intervening time has usually been spent by the physician in waiting to observe whether a suspected stone will pass or not. This is the period most valuable for the patient. The proper procedure to follow in a person over middle age who becomes deeply jaundiced, whether painlessly or not, is to attempt immediately to discover, by means of the duodenal tube, whether the main ducts in the region suspected are absolutely blocked or not. If they are, one or both of them, the diagnosis of new growth should be made; the case should at once become a surgical one, and no further time be spent in "watchful waiting." A cholecystenterostomy at this time will be of greater assistance to the patient and prevent the dire consequences of a fully established malignant icterus. The mortality of this preliminary operation would probably be very much lower at this time than when performed months later.

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[21] The following figures are quoted from Clermont's article published in 1912.

[22] Beitr. zur. klin. Chir., 1912, lxxviii, 439. [23] Rev. de Chir., 1909, xxxix, 1135.

Four to six weeks may safely be allowed to elapse. The nature of the growth permits of this delay, for it grows but slowly and has little tendency to metastases. With more assurance and a much better hope of success the second stage of the operation may be undertaken. The successful issue of the radical excision of new growths involving these large ducts will rest in great part on the alacrity with which the physician makes this early diagnosis and calls to his aid a competent surgeon.

General Summary. In most of the new growths involving the bile and pancreatic ducts we are dealing with localized and relatively benign "rodent ulcers." The duodenal tube, in the great majority of cases, allows of early and absolute diagnosis. Delay, with its concomitant cholemia, hemorrhage, and rapid emaciation can thus be avoided and the powers of modern surgery be hopefully invoked to continue, with ever bettering results, a warfare on this type of malignant growth.

THE ABSORPTION OF PROTEIN AND FAT AFTER THE RESECTION OF ONE-HALF OF THE SMALL INTESTINE.

By Walter W. Palmer, M.D.,

HOUSE PHYSICIAN, EAST MEDICAL SERVICE, MASSACHUSETTS GENERAL HOSPITAL.

(From the Medical Service and the Chemical Laboratory of the Massachusetts General Hospital.)

Studies of absorption in cases with extensive resection of the small intestine have been made by several investigators. In August, 1913, Dr. E. A. Codman removed from a woman, aged forty years,